Table 8. Summary of Visions for Ecosystem Elements (continued).

| Ecosystem Element | Vision Summary |
|---|---|
| Delta Mudwort | The vision for delta mudwort is to contribute to the recovery of this California Native Plant Society List 2 plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Crampton's Tuctoria | The vision for Crampton's tuctoria is to contribute to the recovery of this Federally and State listed endangered species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Alkali Milkvetch | The vision for alkali milkvetch is to contribute to the recovery of this California Native Plant Society List 1B plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Point Reyes Bird's-Beak | The vision for Point Reyes bird'-beak is to contribute to contribute to the recovery of this California Native Plant Society List 1B plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Delta Coyote-Thistle | The vision for the Delta coyote-thistle is to contribute to the recovery of the State listed endangered species and California Native Plant Society List 1B plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| **MAINTAIN ("M"):** For species designated "m," the CALFED will undertake actions to maintain the species. This category is less rigorous that "contribute to recovery." The goal "maintain" was assigned to species expected to be minimally affected by CALFED actions. | |
| Western Least Bittern | The vision for the Western least bittern is to contribute to the recovery of this California species of special concern to contribute to the overall species richness and diversity. Achieving this vision will reduce conflict between protection for this species and other beneficial uses of land and water in the Bay-Delta. |
| California Tiger Salamander | The vision for the California tiger salamander is to maintain existing populations of this Federal candidate species in the Bay-Delta. |
| Western Spadefoot Toad | The vision for the western spadefoot toad is to maintain this California species of special concern in the Bay-Delta. |
| California Red-Legged Frog | The vision for the California red-legged frog is to maintain populations of this Federally listed threatened species. Achieving this vision will contribute to the overall species richness and diversity and to reduce conflict between protection for this species and other beneficial uses of land and water in the Bay-Delta. |
| Native Anuran Amphibians | The vision for native anuran amphibians is to contribute to their restoration in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. Note: western spadefoot and California red-legged frog are discussed individually. |

Table 8. Summary of Visions for Ecosystem Elements (continued).

| Ecosystem Element | Vision Summary |
|---|---|
| Western Pond Turtle | The vision for the western pond turtle is to maintain the abundance and distribution of this California species of special concern in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Hardhead | The vision for hardhead is to maintain and abundance and distribution of this California species of special concern in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| California Freshwater Shrimp | The vision for the California freshwater shrimp is to maintain populations of this Federally listed endangered species by maintaining its existing distribution and abundance in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Recurved Larkspur | The vision for recurved larkspur is to maintain populations of this California Native Plant Society List 1B plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Mad-dog Skullcap | The vision for mad-dog skullcap is to maintain populations of this California Native Plant Society List 2 plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Rose-mallow | The vision for rose-mallow is to maintain populations of this California Native Plant Society List 2 plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Eel-grass Pondweed | The vision for eel-grass pondweed is to maintain populations of this California Native Plant Society List 2 plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Colusa Grass | The vision for Colusa grass is to maintain populations of this Federally listed threatened and State listed endangered species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Boggs Lake Hedge-hyssop | The vision for Boggs Lake hedge-hyssop is to maintain populations of this State listed endangered species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Contra Costa Goldfields | The vision for Contra Costa goldfields is to maintain populations of this Federally listed endangered species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |

Table 8. Summary of Visions for Ecosystem Elements (continued).

| Ecosystem Element | Vision Summary |
|---|---|
| Greene's Legenere | The vision for Greene's Legenere is to maintain populations of this California Native Plant Society List 1B plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Heartscale | The vision for heartscale is to maintain populations of this California Native Plant Society List 2 plant species in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| **ENHANCE AND/OR CONSERVE BIOTIC COMMUNITIES "E":** For those species designated "E," the CALFED Program will undertake actions to maintain the diversity, distribution and abundance of native biotic communities in the estuary and watershed. | |
| Native Resident Fish Species | The vision for resident fish species is to maintain and restore the distribution and abundance of native species, such as Sacramento blackfish, hardhead, hitch, and tule perch in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Bay-Delta Aquatic Foodweb Organisms | The vision for the Bay-Delta aquatic foodweb organisms is to maintain and restore the Bay-Delta estuary's once-productive food base of aquatic algae, organic matter, microbes, and zooplankton communities in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Shorebird and Wading Bird Guild | The vision for the shorebird and wading bird guild is to maintain and restore healthy populations of shorebirds and wading birds through habitat protection and restoration and reduction in stressors in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Migratory Waterfowl | The vision for waterfowl is to maintain and restore healthy populations at levels that can support consumptive (e.g., hunting) and nonconsumptive (e.g., birdwatching) uses consistent with the goals and objectives of the Central Valley Habitat Joint Venture as part of the North American Waterfowl Management Plan in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| Neotropical Migratory Bird Guild | The vision for the neotropical migratory bird guild is to maintain and restore healthy populations of neotropical migratory birds through restoring habitats on which they depend in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. Note: several neotropical species are discussed individually. |
| Anadromous Lampreys | The vision for anadromous lampreys is to maintain and restore population distribution and abundance to higher levels than at present, to better understand life history, and identify factors which influence abundance in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |

Table 8. Summary of Visions for Ecosystem Elements (continued).

| Ecosystem Element | Vision Summary |
|---|---|
| Upland Game | The vision for upland game is to maintain and restore healthy populations of native upland game species at levels that can support both consumptive (e.g., hunting) and nonconsumptive (e.g., birdwatching) uses, through protection and improvement of habitats and reduction in stressors. |
| Plant Community Groups | The vision for plant community groups is to maintain and restore existing and rehabilitate degraded habitats that support the diverse assemblages of plants in the Bay-Delta in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| **MAINTAIN AND/OR ENHANCE HARVESTED SPECIES ("H"):** For those species designated "H" the CALFED Program will undertake actions to maintain the species at levels which support or enhance sustainable harvest rates. The goal "maintain harvest" was generally assigned to species which are harvested for recreational or commercial purposes and which may be covered under one of the four previous designations. | |
| Striped Bass | The vision for striped bass is to restore populations to levels of abundance consistent with the Fish and Game Commission's striped bass policy in order to support a sport fishery in the Bay, Delta, and tributary rivers, and to reduce the conflict between protection of striped bass and other beneficial uses of water in the Bay-Delta. |
| White Sturgeon | The vision for white sturgeon is to maintain and restore population distribution and abundance to historical levels to support a sport fishery in order to contribute to the overall species richness and diversity and improve water management for beneficial uses of the Bay-Delta system. |
| American Shad | The vision for American shad is to maintain a naturally spawning population, consistent with restoring native species, that supports a sport fishery similar to the fishery that existed in the 1960s and 1970s. |
| Chinook Salmon | The vision for all chinook salmon evolutionarily significant unit is to recover all stocks presently proposed for listing under the ESA, achieve naturally spawning population levels that support and maintain ocean commercial and ocean and inland recreational fisheries, and that fully use existing and restored habitats. |
| Native Cyprinid Fishes | The vision for native cyprinid fishes is to maintain self-sustaining populations in order to provide opportunities for consumptive uses consistent with recovery of at-risk species. |
| Non-native Warmwater Gamefish | The vision for non-native warmwater gamefish is to maintain self-sustaining populations in order to provide opportunities for consumptive use such as fishing. |
| Pacific Herring | The vision for Pacific herring is to maintain self-sustaining populations in order to support commercial fishing. |
| Grass Shrimp | The vision for grass shrimp is to maintain self-sustaining populations in order to support existing commercial fisheries. |
| Signal Crayfish | The vision for signal crayfish is to maintain self-sustaining populations in order to support recreational and commercial fishing. |

Table 8. Summary of Visions for Ecosystem Elements (continued).

| Ecosystem Element | Vision Summary |
|---|---|
| **Stressors** | |
| Water Diversions | The vision for water diversions is to reduce the adverse effects of water diversions, including entrainment of all life stages of aquatic species, by installing fish screens, consolidating or moving diversions to less sensitive locations, removing diversions, or reducing the volume of water diverted. Achieving this vision will assist in the recovery of State and/or Federally listed fish species, improve important sport fisheries, and improve the Bay-Delta aquatic foodweb. |
| Dams and Other Structures | The vision for dams and other structures is to reduce their adverse effects by improving fish passage and enhancing downstream fish to assist in the recovery of State and/or Federally listed fish species and contribute to sustainable sport and commercial fisheries. |
| Levees, Bridges, and Bank Protection | The vision for levees, bridges, and bank protection is to reduce the adverse effects of these structures in order to improve riverine and floodplain habitat conditions to assist in the recovery of State and/or Federally listed fish species, and other fish and wildlife. |
| Dredging and Sediment Disposal | The vision for dredging and sediment disposal in the Bay-Delta is to maintain adequate channel depth for navigation, flood control, and water conveyance while reducing the adverse effects of dredging activities on the Bay-Delta ecosystem. |
| Gravel Mining | The vision for gravel mining is to improve gravel transport and cleansing by reducing the adverse effects of instream gravel mining in order to maintain or restore flood, floodplain, and streamflow processes that govern gravel supply to improve fish spawning and floodplain habitats. |
| Invasive Aquatic Plants | The vision for invasive aquatic plants is to reduce their adverse effects on native species and ecological processes, water quality and conveyance systems, and major rivers and their tributaries. |
| Invasive Aquatic Organisms | The vision for invasive aquatic organisms is to reduce their adverse effects on the foodweb and on native species resulting from competition for food and habitat and direct predation. This vision can be accomplished through enforcement of State laws regulating ballast water dumping and other measures designed to reduce the number of new, potentially harmful species introduced accidentally into the Bay-Delta estuary. Habitat changes or direct control measures may reduce their effects in specific cases. |
| Invasive Riparian and Marsh Plants | The vision for invasive riparian and salt marsh plant species is to reduce their adverse effects on native species and ecological processes, water quality and water conveyance systems, and major rivers and their tributaries. |
| Zebra Mussel | The vison for zebra mussel is to establish procedures to prevent or delay their introduction and to set up protocols to swiftly treat and eliminate any introduction. |
| Non-Native Wildlife | The vision for non-native wildlife species is to implement a program to reduce the numbers of harmful non-native wildlife species (i.e., those that threaten the diversity or abundance of native species or the ecological stability of an area). |

Table 8. Summary of Visions for Ecosystem Elements (continued).

| Ecosystem Element | Vision Summary |
|---|---|
| Predation and Competition | The vision for predation and competition is to reduce unnatural levels to restore fish populations by removing, redesigning, or reoperating in-water structures, diversion dams, and hatchery practices. |
| Contaminants | The vision for contaminants is to ensure that all waters of mainstem rivers and tributaries entering the Bay-Delta, and all waters of the Bay-Delta, are free of deleterious concentrations of toxic substances |
| Fish and Wildlife Harvest | The vision for fish and wildlife harvest is to support strategies that maintain a sustainable commercial and recreational chinook salmon fishery in a manner consistent with the recovery of individual stocks; steelhead trout harvest strategies that fully protect naturally spawning stocks while redirecting harvest to hatchery-produced stocks; the continued legal harvest of striped bass and reduction of illegal harvest; and the present white sturgeon harvest strategy, which protects the species from overexploitation while providing a sustainable trophy fishery. |
| Artificial Fish Propagation | The vision for the artificial propagation of fish is to modify existing hatcheries and hatchery practices in ways to augment salmon and steelhead populations without having detrimental effects on naturally spawning populations of salmon and steelhead. |
| Stranding | The vision for stranding is to reduce the magnitude of the number of aquatic organisms lost when rivers recede or overflow into flood bypasses and to reconnect areas that become isolated with flowing water and to reduce the frequency by which low-lying areas are inundated. |
| Disturbance | The vision for disturbance is to reduce the adverse effects of boating and other recreational activities, temporary habitat disturbances, and other human activities on wildlife and their habitats in the Bay-Delta. |

## REFERENCE

Multi-Species Conservation Strategy. 2000. CALFED Bay-Delta Program, Programmatic EIS/EIR Technical Appendix. July 2000.

# ◆ ECOLOGICAL PROCESS VISIONS

## INTRODUCTION

This section presents visions for ecological processes. Ecological processes act directly, indirectly, or in combination, to shape and form the ecosystem. These include streamflow, stream channel, floodplain, and foodweb processes. Stream channel processes include stream meander, gravel recruitment and transport, water temperature, and hydraulic conditions. Floodplain processes include overbank flooding and sediment retention and deposition. Physical and biological processes addressed are those that have a strong effect in shaping and influencing the Bay-Delta ecosystem. These processes can also be managed to improve the health of the Bay-Delta ecosystem and its resources. Table 9 identifies important ecological processes and the related Strategic Plan objective. Table 10 presents the basis for their selection as an ecosystem element.

Visions describe the role and importance of each process in maintaining the health of the Bay-Delta, and a description of how the process currently operates in the ecosystem, stressors and changes to other processes that have altered how the process operates in the ecosystem. The Strategic Plan objectives, targets, programmatic actions, and conservation measures are presented here and more fully described in Volume II: Ecological Management Zone Visions. Table 11 presents the ecological management zone in which Strategic Plan objectives, targets, programmatic actions, and conservation measures have been proposed to accomplish each ecological process vision.

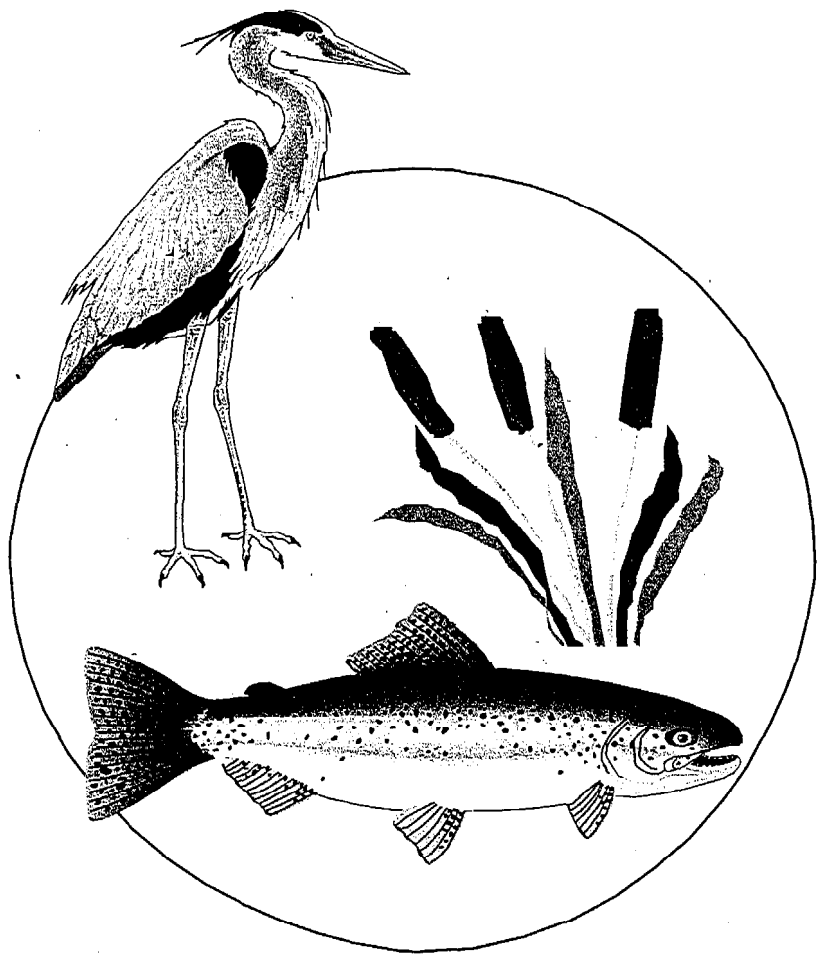

Table 9. Strategic Plan Goal and Objectives for Ecological Processes.

| *Goal 2. Rehabilitate natural processes in the Bay-Delta estuary and its watershed to fully support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native members of those communities.* | |
|---|---|
| **Ecological Process** | **Strategic Plan Objective** |
| Central Valley Streamflows<br>and<br>Central Valley Stream Temperatures | Establish and maintain hydrologic and hydrodynamic regimes for the Bay and Delta that support the recovery and restoration of native species and biotic communities, support the restoration and maintenance of functional natural habitats, and maintain harvestable species.<br><br>Establish hydrologic regimes in streams, including sufficient flow timing, magnitude, duration, and high flow frequency, to maintain channel and sediment conditions supporting the recovery and restoration of native aquatic and riparian species and biotic communities.<br><br>Create and/or maintain flow and temperature regimes in rivers that support the recovery and restoration of native aquatic species. |
| Coarse Sediment Supply | Restore coarse sediment supplies to sediment-starved rivers downstream of reservoirs to support the restoration and maintenance of functional natural riverine habitats. |
| Stream Meander | Increase the extent of freely meandering reaches and other pre-1850 river channel forms to support the restoration and maintenance of functional natural riverine, riparian, and floodplain habitats. |
| Natural Floodplains and Flood Processes | Re-establish floodplain inundation and channel-floodplain connectivity of sufficient frequency, timing, duration, and magnitude to support the restoration and maintenance of functional natural floodplain, riparian and, riverine habitats. |
| Bay-Delta Hydrodynamics | Establish and maintain hydrologic and hydrodynamic regimes for the Bay and Delta that support the recovery and restoration of native species and biotic communities, support the restoration and maintenance of functional natural habitats, and maintain harvestable species. |
| Bay-Delta Aquatic Foodweb | Increase estuarine productivity and rehabilitate estuarine food web processes to support the recovery and restoration of native estuarine species and biotic communities. |

Table 10. Basis for Selection of Ecological Process Ecosystem Elements.

| Ecological Process | Basis for Selection as an Ecosystem Element |
|---|---|
| Central Valley Streamflows<br><br>and<br><br>Central Valley Stream Temperatures | Virtually all streams in the region are regulated to a greater or lesser degree and the regulated flow regimes frequently favor non-native fishes. The native fish assemblages (including those with anadromous fishes) are increasingly uncommon. Recent studies in Putah Creek, the Stanislaus River, and the Tuolumne River demonstrate that native fish assemblages can be restored to sections of streams if flow (and temperature) regimes are manipulated in ways that favor their spawning and survival, usually by having flow regimes that mimic natural patterns and increasing flows during summer months. Native invertebrates and riparian plants may also respond positively to these flow regimes. Achievement of this objective will require additional experimentation with flows below dams (or the re-regulation of existing flow regimes) to determine the optimal flow/habitat conditions for native organisms, as part of the short term goal. Part of the studies should be to determine if the objective can be achieved without 'new' water, by just altering the timing of releases or by developing conjunctive use agreements that allow more water to flow down the stream channel. These findings can then be applied opportunistically to achieve the long-term goal.<br><br>Native aquatic and riparian organisms in the Central Valley evolved under a flow regime with pronounced seasonal and year to year variability. Frequent (annual or biannual) high flows mobilized gravel beds, drove channel migration, inundated floodplains, maintained sediment quality for native fishes and invertebrates, and maintained complex channel and floodplain habitats. By deliberately releasing such flows from reservoirs, at least some of these physical and ecological functions can probably be recreated. A program of such high flow releases (commonly termed 'flushing flows') lends itself well to adaptive management, because the flows can easily be adjusted to determine the level needed to achieve specific objectives. However, it should be recognized that channel adjustments may lag behind hydrologic changes by years or decades, which requires that monitoring be long-term. Also, on most rivers, reservoirs are not large enough to eliminate extremely large, infrequent events so these will continue to affect channel form at irregular intervals; artificial high flow events may be needed to maintain desirable channel configurations created during the natural events. This objective is similar to the previous one, but differs in its focus on high flow events that are likely to be higher than those needed to maintain most native fish species but important for maintaining in-channel and riparian habitats for other species (invertebrates, birds, mammals, etc.). |

Table 10. Basis for Selection of Ecological Process Ecosystem Elements (continued).

| Ecological Process | Basis for Selection as an Ecosystem Element |
|---|---|
| Coarse Sediment Supply | One of the major negative effects of dams is the capture of coarse sediments that naturally would pass on to downstream areas. As a result, the downstream reaches can become sediment starved, producing 'armoring' of streambeds in many (but not all) rivers to the point where they provide greatly reduced habitat for fish and aquatic organisms and are largely unsuitable for spawning salmon and other anadromous fish. Accomplishing this objective can be done by a wide variety of means, but most obviously through artificial importation of gravel and sand. Other possible actions include: (1) explore the feasibility of passing sediment through small reservoirs; (2) remove nonessential or low-value dams; (3) eliminate instream gravel mining on channels downstream of reservoirs, and limit extraction on unregulated channels to 50 percent of estimated bedload supply or less (or levels determined not to negatively impact fish and other ecological resources); (4) develop incentives to discourage mining of gravel from river channels and adjacent floodplain sites; and (5) develop programs for comprehensive sediment management in each watershed, accounting for sediment trapped by reservoirs, availability of sediment from tributaries down stream of reservoirs, loss of reservoir capacity, release of sediment-starved water downstream, channel incision and related effects, and the need for sources of construction aggregate. |
| Stream Meander | Freely migrating rivers have the highest riparian and aquatic habitat diversity of all riverine systems. Through the process of meandering, eroding concave banks and building convex banks, the channel creates and maintains a diversity of surfaces that support a diversity of habitats, from pioneer riparian plants on newly deposited point bars to gallery riparian forest on high banks built of overbank silt deposits. Similarly, wandering or braided rivers support distinct habitat types and thus are beneficial to maintain. Flood plain restoration can also increase flood protection for urban areas and increase the reliability of stored water supplies in reservoirs (because reservoirs can be maintained at higher levels because of reduced need to catch flood waters). |
| Natural Floodplains and Flood Processes | Frequent (usually annual or biannual) flood plain inundation was an important attribute of the original aquatic systems in the Central Valley and was important for maintaining diverse riverine and riparian habitats. Important interactions between channel and floodplain include overflow onto the floodplain, which (1) limits shear stress exerted on the bed, reducing channel incision, (2) acts as a "pressure relief valve," permitting a larger range of sediment grain sizes to remain on the channel bed, (3) increases the complexity and diversity of instream and riparian habitats, and (4) stores flood water (thereby decreasing flooding downstream). The floodplain also provides shading, food organisms, and large woody debris to the channel. Floodplain forests serve as filters to improve the quality of water reaching the stream channel by both surface flow and groundwater. The actions necessary to re-establish active inundation will probably require major land purchases or easements, and financial incentives to move existing floodplain uses elsewhere, as has been done in the Midwest since the severe floods of the Mississippi River and its tributaries in 1993. |